Idaho National Engineering and Environmental Laboratory

Selective Copper Concentration from Heap Leach Operations

The need to develop efficient methods for removing copper from heap leach solutions without mobile organic phases is major to the mining industry today. Current technologies remove the metal values from solutions in three steps: (1) metals mobilization, (2) metals capture/concentration in an organic phase, (3) metals release/stripping into an aqueous phase. This process is known as solvent extraction. The organic phases used to concentrate the metal ions are expensive and not as ion specific as desired. Also, the extractant is lost, which is both expensive and environmentally unacceptable. This research project seeks to simplify the solvent extraction process and eliminate the mobile organic phase. Economically, the overall process would be highly cost competitive.

Objectives

- Review the literature of interest since FY-97.
- Determine the best set of potential linker molecules.
- Determine the best coupling agent chemistry for modifying the silica surface.
- Evaluate the most efficient synthetic methods for coupling the head group to linker to surface.
- Prepare compounds with different linker molecules.
- Evaluate different compounds for copper specificity.
- Choose the best system for selective copper removal from an acidic solution for possible scale-up.
- Seek industrial partners for support of scale-up.

Accomplishments

The exact nature of the copper ion-specific chelation group and the types of linker molecules are Lockheed Martin Idaho proprietary and therefore we do not describe them in detail here. We present general accomplishments only. This project has made significant progress in synthesizing solid-phase extractants. We determined two approaches to be appropriate for the work. The Rosenberg group at the University of Montana (UM) pursued the first method. Their technology is based on building metal ion-specific groups on polymers, then using coupling agent chemistry and specific reaction conditions to covalently bond the polymer species to silica surfaces. The INEEL independently pursued the second method. This synthetic method is based on building the molecules in three parts—the head or metal ion chelation group, the linker group, and the appropriate surface bonding group—followed by linking the three together to form a surface covered with brush-like metal ion capture groups. Both methods show strong possibility for generating metalion-specific chelation materials.

We met all of the technical objectives stated above. We have a specific set of molecules that exhibit strong preference for copper over iron ions. Additionally, we found an industrial partner and have proposed a cooperative research and development agreement for their consideration. Their initial responses indicate that they will fund the future work.

New or Increased Technical Capability

This two-year research project has resulted in a new set of materials that selectively capture specific metal ions but not other chemically similar ones. The technology may well be used to decrease the pollution caused by current solvent extraction systems. It has additional potential for increasing the profits of the mining industry, and it has brought the INEEL to the leading edge of technology development for the industry. The project has proposed cooperative research with the industry. And the technology has potential for licensing.

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